

How to make a guided parafoil system - an introductory guide for NSE

If NSE chooses to continue with guided parafoil research, this page should have everything you need to know in order to get started. None of this will be easy (unless you're a genius like Benji) and I guarantee that every single step of the process will take way more time than reasonable. Failure does not mean that you are doing anything wrong, it is simply part of the process.

Best of luck with building parafoil systems or whatever else you choose to do this year,
- Reed

Complete parts list

- An Arduino Uno board. The club should have several of these already.
- An HS 785HB winch servo motor. The club has one, but it may be beneficial to eventually switch to using two smaller winch servo motors instead of one large one.
- An Adafruit Ultimate GPS Breakout board (I might send one, or you can purchase one here for \$40: <https://www.adafruit.com/product/746>). These are hard-programmed to shut down above 18,000 meters, so it may be best to eventually find a different GPS module to use. Use the Adafruit one for now, because it works with the guidance program I wrote. The use of a different GPS module will require all GPS-related code in the guidance program to be rewritten.
- Several 9V lithium batteries. Exactly how you choose to power the Arduino and other components is up to you. Just be sure to link all of the things' ground pins to each other.
- An SD card adaptor board. The club should have one, and they're available online.
- Wires.
- A 5V voltage regulator. Ask Mr. Blount for one or get them for cheap online.
- Optional: An external GPS antenna for better signal reception. The club has some of these, but you will also need...
- a short U.FL to SMA adaptor cable to connect an external antenna to the GPS board. I will send one of those adaptors to the school just in case the club does not have one already.

Assembly and programming

Refer to the circuit diagram on page 8 of the flight summary document (<https://bit.ly/2Z2bXZr>) for information on how to wire everything together. If you wish to include an accelerometer (or any other additional module, for that matter), in your guided parafoil system, be aware that it will require a lot more wiring and a lot more trial-and-error programming.

A simplified version of the guidance code, intended to be added to and improved, is available here: <https://gitlab.com/reedcspurling/guided-parafoil>. Get the Arduino IDE, copy the guidance code into a new Arduino IDE window, and follow the two links near the top of the guidance code to download the necessary libraries. Use a USB A to USB B adaptor cable to upload the code to the Arduino. I recommend starting small. Begin by verifying that the code will actually run on the Arduino, and google the error messages if it doesn't. Learn how to use the `Serial.print(F())` function and the Serial monitor to find where errors are occurring in the code, and what outputs various parts of the code are generating. Comment lines out and see what works and what doesn't. Wire the GPS receiver to the Arduino and repeat the process. Continue adding components one by one. Read the data sheets!

Flight

Refer to the flight summary document for specific recommendations, and remember that beyond those recommendations, I'm just as clueless as the rest of you when it comes to flying parafoils. Having a functional parafoil deployment system would be incredibly useful, and if NSE is going to be working on guided parafoils at all, I suggest that y'all prioritize conducting a study of parafoil and/or parachute deployment mechanics. Let me know if you find anything interesting. :)